

WHAT IS CLAIMED IS:

1. A method of cleaning a dual damascene structure, comprising:

providing a substrate, wherein a first metal layer, a cap layer, and a dielectric layer are formed in sequence on the substrate;

5 forming a dual damascene opening in the dielectric layer and the cap layer to expose the first metal layer;

performing a post-etching cleaning step to clean the dual damascene opening using a fluorine-based organic solvent; and

10 sputtering an argon gas to clean the dual damascene opening before forming a second metal layer in the dual damascene opening.

2. The method of claim 1, wherein the fluorine-based organic solvent includes an organic solvent with fluoride acetate acid as a principal solvent.

3. The method of claim 2, wherein the fluorine-based organic solvent has a chelating agent and an oxidizing agent.

15 4. The method of claim 1, wherein the fluorine-based organic solvent includes an organic solvent with ammonium fluoride as a principal solvent.

5. The method of claim 4, wherein the fluorine-based organic solvent has a chelating agent and an oxidizing agent.

20 6. The method of claim 1, wherein a sputtering power is between 75 and 300 watts to sputter the argon gas in the dual damascene opening.

7. The method of claim 1, wherein a sputtering time is about 10 to 30 seconds to sputter the argon gas in the dual damascene opening.

8. The method of claim 1, wherein the material of the cap layer is silicon nitride (SiN).

9. The method of claim 1, wherein the material of dielectric layer has a low dielectric constant (low-k), and is silicate based or an organic material.

10. A method of cleaning a dual damascene structure, comprising:

providing a substrate, wherein a first metal layer, a cap layer, and a dielectric

5 layer are formed in sequence on the substrate;

forming a dual damascene opening in the dielectric layer and the cap layer to expose the first metal layer;

performing a first post-etching cleaning step to clean the dual damascene opening using an oxidizing agent based solvent;

10 performing a second post-etching cleaning step to clean the dual damascene opening using a hydrofluoric acid solvent; and

sputtering an argon gas to clean the dual damascene opening before forming a second metal layer in the dual damascene opening .

11. The method of claim 10, wherein the oxidizing agent based solvent has a  
15 hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) based solvent.

12. The method of claim 11, wherein the hydrogen peroxide based solvent is a mixture of hydrogen peroxide and water at a ratio of between 1:24 and 1:80.

13. The method of claim 11, wherein a stable temperature controls the reaction of the hydrogen peroxide solvent and prevents over oxidizing on the first metal layer.

20 14. The method of claim 13, wherein the temperature is between 40 and 60 Celsius.

15. The method of claim 10, wherein the hydrofluoric acid solvent is a mixture of hydrofluoric acid and water at a ratio of 1:600.

16. The method of claim 10, wherein a sputtering power is between 75 and 300 watts to sputter the argon gas in the dual damascene opening.

17. The method of claim 10, wherein a time of sputtering the argon gas in the dual damascene opening is between about 10 and 30 seconds.

5 18. The method of claim 10, wherein a material of the cap layer is silicon nitride (SiN).

19. The method of claim 10, wherein the material of the dielectric layer has a low dielectric constant (low-k), and is silicate based or fluorine carbide.

20. The method of claim 10, wherein a material of the first metal layer is copper.

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